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"Nosey Parker"

Works visits to-day form an important part of the activities of learned and technical associations. Participants have their attention directed to large or modern machines, yet they cannot see very much beyond the external castings and the exposed working parts. They do, however, take notice of the manufacturers' name-plate or device, and the reproduction of these is very largely the affair of the foundry, using the word to include the patternshop. Shortly before this last war, a new factory was opened in a Garden City. It was visited by a dozen or more engineering and metallurgical societies, the members of which inspected with interest a line of presses. These bore the name of a famous maker, but the lettering was so badly done that anybody would have been forgiven for ascribing their production to a fifth-rate foundry. We informed the managing director of the supplying firm, who immediately sent down a man to effect belated repairs.

Recently, a plant manufacturer consulted us as to a supplier of nameplates in the form of malleable-iron castings, as his previous source of supply had failed to function. In his case the nameplate is either at floor level or high up, so we suggested the use of a vitreous enamelled plate as being more attractive, with what result we have still to learn. What was suggested in this case is worth emulation by the foundries. The main considerations are freedom from difficulty in moulding and boldness—by which we mean ease in reading at a reasonable distance. Whilst standard letters are available, often, additional clarity and beauty can be obtained by employing an artistic designer. If, as experience shows, the nameplate is always scanned by visitors, then, by offering to a customer or another department of one's own organisation improved lettering for body castings, one can materially help with future sales. We know of a few foundries which regularly receive worthwhile orders for components which carry a nameplate because of their reputation for high-class lettering. One concern embellishes them by vitreous enamelling. It is becoming more and more common for engineering works to adopt colour schemes, which include, of course, the plant installed. Here is a case for useful and perhaps crafty co-operation. The suppliers can offer to colour the machine before delivery to the specification imposed by the customer, whilst picking out the lettering in a contrasting colour. We have noticed that some lettering tends to become masked after receiving a coat of uni-colour paint.

People *are* interested in the names of suppliers of equipment, and we recall that many years ago we visited, in company with an assistant, an important cup-tie. We became "fed up" with this youngster's constant brag that he could identify every make of motor-car. Arriving at the match, we noticed a car of curious design parked well to the rear, and remarked that here at last was one he did not recognise. His curiosity aroused, he scrambled through the serried ranks, his face reddened, and on being questioned, he replied modestly that on the wheel-hub it said "Nosey Parker." We reiterate that experience has taught us that a similar mental attitude is shown by most visitors to works. This being the case, do, for the sake of the industry, give them some nice lettering to look at and to create a favourable and enduring impression.

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40 Years Ago

The October, 1908, issue of the JOURNAL "debunks" Dr. W. Rathenau, of the A.E.G., Berlin, who criticised the lack of trained technicians in this country. It contains Mr. J. Smith's Paper on propeller making—probably the first on this subject—and a description of the Ardelt pipe-moulding machine. It also announces the appointment of Mr. G. Shaw Scott as secretary of the Institute of Metals.

Papers for the Annual Conference

The Council of the Institute of British Foundrymen is prepared to receive offers of Papers for presentation at the 46th Annual Conference to be held at Cheltenham from June 14 to 17, 1949. Members or non-members who contemplate offering Papers (the manuscripts of these will be required early in the New Year) are requested to communicate as soon as possible with the Secretary of the Institute, who will then forward them a copy of the Institute's publication, "Notes for the Guidance of Authors of Papers."

"The Story of Timber"

This film strip is one of the series being prepared by Educational Productions, Limited, 17, Denbigh Street, S.W.1, in collaboration with the Timber Development Association. Number 2, "The Growth and Structure of Timber," has already been released, and charts are now available in connection with the strips. This new strip illustrates trees in the natural state, and continues with the felling, methods of transport, sawmills and conversion of timber, concluding with brief details of plywood manufacture. The strip is for use in handicraft classes for putting over the general story of timber, and should also be of interest to those connected with patternmaking. There are twenty-six frames complete with notes, and the price is 15s.

Thermit Welding

Descriptions of the techniques of foundry and welding shop were to some extent combined in a lecture on Thermit welding by Mr. A. Baines (of Richard, Thomas & Baldwin's) to the North London Branch of the Institute of Welding. The Author dealt in a practical manner with the application of the process to steelworks' repairs to castings and forgings of considerable magnitude. There were no dissentients at the meeting to the view that by no other means could such large projects as those illustrated have been carried out so satisfactorily. An interesting sidelight of the discussion was the information that molten Thermit steel costs about 2s. per lb.—a modest figure considering the simplicity of the tackle required to produce it.

THE 26TH IDEAL HOME EXHIBITION will be held at Olympia from March 1 to March 26, 1949.

Forthcoming Events

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

NOVEMBER 1.

Institution of Production Engineers.

Yorkshire Section:—"Management," by Lt.-Col. C. W. Mustill, M.B.E., at the Hotel Metropole, Leeds.

NOVEMBER 2.

The Institute of Metals.

South Wales Local Section:—"Controlled Atmospheres in Non-ferrous Metallurgy," by Ivor Jenkins, M.Sc., at the University College, Swansea, at 6.30 p.m.

Institution of Works Managers.

Leeds Branch:—"The Psychology of Management," by A. D. Jenkins, at the Great Northern Station Hotel, Leeds, at 7 p.m.

NOVEMBER 3.

Institution of Production Engineers.

Preston Section:—"Metal Spraying," by W. Wall, at the Harris Institute, Preston, illustrated by a film.

Wolverhampton Section:—"Production Engineering in Relation to the National Economy," by B. H. Dyson.

NOVEMBER 3 and 4.

Institution of Mechanical Engineers.

Series of Lectures on Internal Combustion Turbines by the staff of the National Gas Turbine Establishment, Farnborough, at Storey's Gate, St. James's Park, London, S.W.1.

NOVEMBER 4.

Institute of Vitreous Enamellers.

Midland Section:—"Preparation of Metal for Enamelling," by Mr. Silman, at the Chamber of Commerce, New Street, Birmingham, at 7.15 p.m.

The Institute of Metals.

Birmingham Local Section:—Students' Evening at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 6.30 p.m.

NOVEMBER 5.

Institute of British Foundrymen.

West Wales Section:—Mechanical Aids to Core-making," by J. Blakiston, in Baldwin's Canteen, Landore Works, Swansea, at 7 p.m.

Manchester Association of Engineers

"Engineering Equipment of Factory Buildings," by C. G. Huntley and F. Buckingham, B.Sc., at the Engineers' Club, 17, Albert Square, Manchester, at 6.45 p.m.

NOVEMBER 6.

Institute of British Foundrymen.

West Riding of Yorkshire Branch:—Visit to Catton and Company, Limited, Leeds. Assemble at works entrance at 3 p.m.

The Solidification of Metals

Dr. E. Scheuer, of International Alloys, Limited, has sent us the following corrigenda to his Paper published in our issues of September 9 and 16.

Page 246: *Paragraph* 2

Dendrites: The Author apologises for having given a faulty explanation of this word in the original text. It is derived from the Greek word Dendron = Tree. (See Concise Oxford Dictionary).

Page 247: *Fig.* 5

For "Ingot about 1¾ natural size" read "Ingot about natural size." For ". . . 12 per cent. Mg . . ." read ". . . 0.12 per cent. Mg . . ."

MR. J. H. D. HOBSON has now arrived at Bulawayo and has taken over the management of F. Issels & Sons, Limited, engineers and ironfounders. Prior to leaving this country, Mr. Hobson was foundry manager, Tees Side Bridge and Engineering Works, Limited, Stockton-on-Tees.

A Study of Residual Gases in Cast Iron*

Important Effects of Relatively Small Quantities

By J. E. Hurst, D.Met., M.I.M., and R. V. Riley, Ph.D., B.Sc., A.I.M.

Synopsis

Introduction—Methods for the determination of gases in cast iron—Vacuum-fusion apparatus and method—The analysis of evolved gas samples—Sampling of iron for vacuum fusion—The degree of accuracy of vacuum-fusion analysis—Reporting of gas analyses—The effect of storage on the gas content of iron—The segregation of gases in cast iron—The effect of remelting of iron on its gas content—The influence of the composition of cast iron on its residual gas content—Effect of gas content in iron on its micro-structure, physical and mechanical properties—and gas content and its significance in the production of sound castings.

Introduction

For over fifty years the occurrence of gases in iron and steel has been a subject for considerable speculation and conjecture. The literature is, therefore, very voluminous, and since the beginning of this century over one thousand separate articles have been published. Reference is made to these in a very comprehensive bibliography prepared by the British Cast Iron Research Association.[1] It might be imagined that with all this attention the subject would now be well understood and be capable of interpretation according to well-established scientific laws of cause and effect. Unfortunately, this is not so, not even with steel, and certainly to an even lesser extent with cast iron.

It is well known that certain commonly-occurring gases do dissolve in cast iron. When solid cast iron is subjected to a gas analysis the gases hydrogen, carbon-monoxide and nitrogen are found. Other gases may occur in iron, but their presence has never been confirmed with certainty. The range of solubility of these gases at various temperatures, either singly or together in solid and liquid cast iron, has not been determined. The practical experimental difficulties in the way are very great. Current ideas on gaseous solubilities are developed from the relatively few fundamental researches by Sieverts and others who have used in their experiments iron of high purity and a single gas, *i.e.*, hydrogen. The multiple effect of the three gases, hydrogen, carbon-monoxide and nitrogen, each of which might be capable of forming compounds with the other gases or with the constituent solid elements in cast iron, is too complicated even to contemplate. It is not surprising, therefore, that the amount of reliable data on this subject is scanty.

It is not the purpose of the present Paper to deal with the historical aspects of the subject, nor even to treat in an exhaustive manner all the hypotheses and theories which have been advanced. Its purpose is rather to extract from the Authors' own experimentally-determined data, matter of interest to the cast-iron foundryman and metallurgist.

(1) Methods for the Determination of Gases in Cast Iron

The estimation of the gases present in a molten metal has often been attempted, but has seldom been carried out to the complete satisfaction of the investigator or his critical contemporaries. The balloon-tube method of W. C. Newell[2] probably comes nearest perfection. The apparatus consists of an evacuated or nitrogen-purged steel tube sealed with a copper disc at the lower end. The upper end is connected to a rubber balloon. The lower end of the apparatus is plunged into the molten metal and a plug of solid metal is formed in the tube. Any gas given off during solidification is collected in the balloon and can be estimated in the laboratory. The gas remaining in the solidified plug is analysed separately.

This type of equipment is not easy to operate under foundry conditions and, furthermore, the sampler is seldom available at the right moment when a liquid metal sample is required. In view of these difficulties it was decided that the bulk of the work done in the Authors' works was to be carried out on solid cast iron, sampled in the manner discussed later.

The only satisfactory method which has been devised for the determination of all the gases remaining in solid iron is with the vacuum-fusion equipment. In this method provision is made for the complete extraction of the retained gases from a sample of cast iron melted in the apparatus and for collection of these gases for analysis. This apparatus gives reliable results for the residual content in cast iron of hydrogen, oxygen and nitrogen. There are chemical methods for the estimation of oxygen and nitrogen in iron, but they are time-consuming and very complicated, so that they show no advantage over the vacuum-fusion method. Furthermore, the all-important hydrogen still remains to be determined by some form of vacuum-extraction method. It is convenient, therefore, to extract all the gaseous elements from the iron at the same time and then to measure and analyse the resultant gas mixture.

The apparatus used in the Authors' laboratory was in the main similar in type to the equipment described by H. A. Sloman,[3] and is shown diagrammatically in Fig. 1. The principle of vacuum-fusion gas analysis is very simple, but the complicated glass apparatus, practical difficulties and operational skill required make it a somewhat difficult estimation to carry out.

* A communication from the Staveley-Bradley Foster Research Department, presented at the London Conference of the Institute of British Foundrymen, June, 1948.

Residual Gases in Cast Iron

Principle of the Vacuum-fusion Method

The specimen of iron is introduced into a previously de-gassed graphite crucible heated to 1,550 deg. C. in an evacuated furnace tube. The specimen on melting begins to boil, with the evolution of carbon-monoxide, hydrogen and nitrogen. The exact source and mode of production of these gases in the experiment is not known at this stage.

Hydrogen is a common element in ferrous metals, including steel, and it is thought to be present either as atomic hydrogen in the iron lattice or in the form of a loose compound, or in the molecular gaseous form in minute cracks in the mosaic crystal structure or in shrinkage cavities or blowholes. The melting of the iron under vacuum is thought to release the hydrogen from all these sources as a gas which is collected during the vacuum fusion experiment.

The nitrogen may be present in iron in a similar manner. Some support for the "compound" theory of nitrogen in iron is afforded by the identification under the microscope of particles of titanium cyano-nitride in cast iron and, of course, iron and aluminium nitrides also have been isolated.

The exact source of the carbon-monoxide in the evolved gases from iron is even more problematical. There is considerable evidence in the case of steel to suggest that the carbon-monoxide in the vacuum-fusion estimation arises from the reduction of silicates, aluminium-oxide, *etc.*, by carbon from the crucible.

i.e., $SiO_2 + 2C = 2CO + Si$
$Al_2O_3 + 3C = 3CO + 2Al$
} The released Si and Al then dissolve in iron.

With cast iron, however, this simple explanation is not satisfactory, since inclusions of oxygen-bearing compounds are seldom, if ever, detected by the microscope. The complete freedom of cast iron from oxide or silicate inclusions is noteworthy in view of the results of vacuum-fusion analysis in which carbon-monoxide is inevitably present. It is suggested that perhaps carbon-monoxide is present in the iron either in discontinuities or in association with the graphite. It has not been possible so far to prove either of these suppositions, and the exact source of carbon-monoxide remains a mystery. This important difference between steel and cast iron is noteworthy.

(2) Vacuum-fusion Apparatus and Method

The graphite crucible in which the specimens are melted is thermally insulated from the water-cooled silica furnace tube by 150- to 200-mesh graphite powder. The water-cooling jacket is not shown in Fig. 1 in order to simplify the diagram. The graphite crucible and packing evolve gases at high temperature and require out-gassing prior to the introduction of the iron specimens. In order to keep down to reasonable limits the time required for out-gassing, the weight of graphite parts must be at a minimum, which is ensured by adopting the crucible design shown in Fig. 2.

The crucible is heated by high-frequency induction from a 15 k.v.a. spark-gap set. The control panel of the H.F. set and the vacuum-fusion apparatus are seen in the photograph (Fig. 3) taken in the research laboratory. By induction heating, it is possible to heat up the crucible to 2,000 deg. C. for purposes of out-gassing.

The gas evolved from the specimens during fusion is pumped away by an Edwards' Type 7 two-stage mercury-diffusion pump and is collected in a Töpler pump of bulb capacity 1 litre. A rotary mechanical pump, Edwards' Speedyvac Type 2, serves as a backing pump. The ultimate pressure in the apparatus is measured by McLeod gauges reading from 0.00001 mm. to 0.01 mm. The gas collected from each specimen is stored for analysis in an inverted test tube over mercury.

The method of conducting an experiment is briefly as follows:—The prepared cast-iron specimens, usually five or six in number, are placed in the side arm of the silica furnace head, where they are retained in the cold until the apparatus is completely out-gassed. Out-gassing of the furnace crucible assembly is carried out at 1,800 deg. C. for approximately four hours, followed by a final treatment at 2,000 deg. C. for a further two hours. The temperature is then lowered to 1,550 deg. C. and a blank experiment is made. During the blanking process the crucible is maintained at 1,550 deg. C. for ½ hr. during which time the Töpler pump is stroked several times so as to collect in the inverted test tube over mercury any gas that may be evolved. The gas obtained in this way is mainly hydrogen, provided the apparatus is completely leak tight. The percentage of nitrogen in the blank gives a good indication of the state of joint tightness of the equipment.

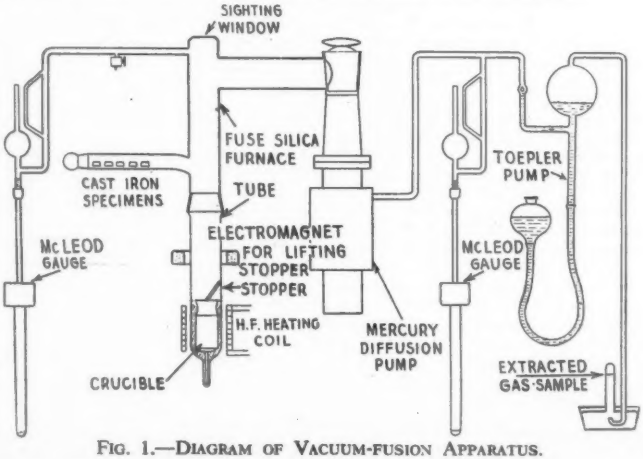

FIG. 1.—DIAGRAM OF VACUUM-FUSION APPARATUS.

The experiment is commenced by the introduction by means of a small hand magnet of one of the specimens from the side arm into the hot crucible. Fusion rapidly occurs and the gases are transferred by the mercury pump to the coarse-vacuum side of the apparatus, where they may be collected by the hand-operated Töpler pump. The evolution of the gases from an average specimen is complete in 20 min., and the pressure in the apparatus is restored to the original pressure before the experiment by repeated stroking of the Töpler pump. The gas sample is collected in this way in a test tube inverted over mercury.

When the gas evolved from the first specimen has been collected completely, the second specimen is introduced into the crucible and the procedure is repeated. At the end of the series the gas from each iron specimen is held in separate test tubes and these gaseous samples may then be measured and analysed.

(3) The Analysis of Evolved-gas Samples

The gas samples obtained from the cast-iron specimens are usually between 5 to 20 ml. and for the analysis of this relatively small amount of gas the Ambler apparatus is most suitable. The variations in volume of the gas sample as each constituent gas is absorbed in reagents is measured by changes in pressure. This type of apparatus proved quite convenient for this work in its modified form shown in Fig. 4. The modification consisted of a large plug-cock having three "on" and three "off" positions. The correct manipulation of this single tap enables the gas analysis to be conducted rapidly without the general fouling of capillaries with the reagents which is otherwise liable to take place with the Ambler apparatus.

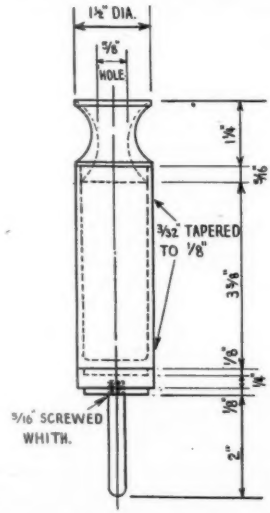

FIG. 2.—DIAGRAM OF GRAPHITE CRUCIBLE USED IN VACUUM-FUSION APPARATUS.

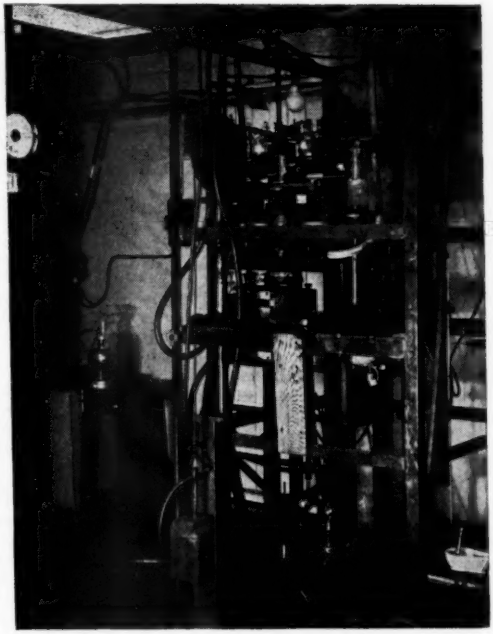

FIG. 3.—PHOTOGRAPH OF VACUUM-FUSION EQUIPMENT IN AUTHORS' LABORATORY.

The gas sample is analysed for carbon-monoxide by absorption in acid cuprous chloride; for hydrogen by combustion with oxygen over a heated platinum spiral; and for nitrogen by difference. Some samples were also tested for carbon-dioxide, methane and thylene, but these gases have never been detected in any but trace amounts in the gas obtained from cast-iron specimens by vacuum fusion.

(4) Sampling of Iron for Vacuum Fusion

A convenient specimen for vacuum fusion gas-analysis consists of a "slug" approximately 1¼ in. long by ⅜ in. dia., as shown in Fig. 5. This sample is conveniently trepanned from pig-iron or a casting by means of a hollow core drill. The core drill is only of value with soft fine-grained irons; if the iron be coarse in structure, the core tends to crumble during drilling; if the iron contains free cementite. the drill rapidly becomes blunted.

With coarse-grained graphitic iron the best method of sampling is to saw a slice from the cross-section of the pig or casting and afterwards to saw from the slice by hand a piece approximately of the correct size. The

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specimen is then ground to a cylindrical shape, by hand, on a small bench grinder. A "white" hard pig is most conveniently cut by means of an emery slitting wheel. The specimen, sliced roughly to shape in this manner, is finally finished by hand grinding as before. Whatever cutting method be used in the sampling of iron for gas-content determination, every care is taken to avoid heating.

The correct position from which to take the sample from pig-iron was the subject of experiment. It is of vital importance to avoid the silica-rich casting skin and any slaggy inclusions which would give spurious "oxygen values." The method finally adopted is to take as a standard sampling point a position along the longitudinal axis approximately central between the notches as shown in Fig. 6. This sampling position corresponded fairly accurately with that from which drillings for chemical analysis are taken by one of the accepted standard methods recognised by the British Cast Iron Research Association.[4]

It is important that grease and oil should not be used to facilitate the cutting of specimens for gas analysis or considerable difficulty may later be met in its removal by solvents. For accurate results complete freedom from all hydro-carbons must be assured. The lack of appreciation of the extreme difficulty experienced in removing every trace of grease from cast iron and pig-iron specimens can result in substantial percentages of methane and unsaturated hydro-carbons being found in the final gas analysis. All specimens of pig-iron for vacuum-fusion gas analysis are cleansed carefully by at least three successive washings in pure ether.

When molten iron is available, the most convenient sample of iron for gas analysis is one taken in a spoon from the bath of the furnace or from the ladle. The spoon sample is then poured into a small stick mould made from a split copper block. The sample stick is ¼ in. dia. by 5 in. long. The surface of the stick made

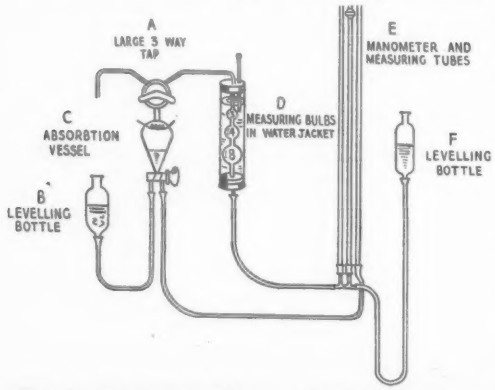


FIG. 4.—DIAGRAM OF MODIFIED AMBLER APPARATUS.

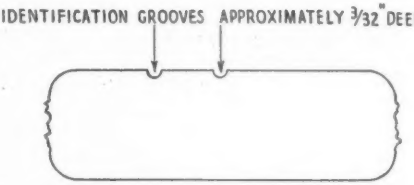


FIG. 5.—DIAGRAM OF SPECIMEN USED IN VACUUM-FUSION GAS ANALYSIS.

Cylindrical Surface and corners ground smooth, approximate size ⅜ in. diam. × 1½ in.

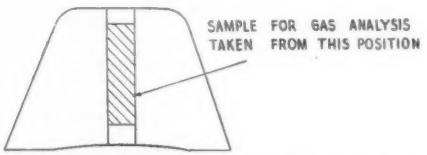


FIG. 6.—DIAGRAM SHOWING SAMPLING OF PIG-IRONS FOR VACUUM-FUSION ANALYSIS.

in the copper mould is very clean and superficial grinding only is required to furnish a bar from which "slugs" of the size and shape shown in Fig. 5 can be prepared. Specimens of cast iron prepared in this way for vacuum-fusion analysis have given comparable results with specimens prepared by sawing or grinding from castings or pig, but the degree of duplication between individual results is better with stick specimens.

(5) The Degree of Accuracy of Vacuum-fusion Gas Analysis

The accuracy attainable in vacuum-fusion analysis on cast irons and pig-irons is being considered by a joint working committee of the British Cast Iron Research Association and the Institute of British Foundrymen. From check determinations made during the course of the present work on samples of all types, it is the Authors' opinion that the values reported are within the following limits of accuracy:—

	Percentage Average Contents.	Degree of Accuracy.
(1) Oxygen	0.001—0.025	± 0.001 of content
(2) Hydrogen ..	0.0001—0.0020	± 0.0001 „ „
(3) Nitrogen	0.001—0.010	± 0.001 „ „

(6) The Reporting of Gas Analyses

The usual method of reporting oxygen and nitrogen values as extracted from fused metals is to give them as percentages involving, of necessity, a number of "noughts." Hydrogen is sometimes reported as a percentage and other times as mls. per 100 grms. of sample. The latter method of expressing hydrogen certainly avoids ambiguity which otherwise might occur with very small amounts of the order of one ten-thousandth to one thousandth of 1 per cent., but it suffers from the defect that it tends to overrate the true amount of hydrogen present in relation to the other gases.

The Authors have given some attention to the question of the best way of reporting gas-analysis figures, and whilst the ideal method cannot be claimed to have been found, it is felt that there is some merit in expressing the results as weight percentages in whole numbers multiplied by 10^{-4}. This has been done in the results quoted in this work, but in some cases the more usual system of expression has also been included.

When results are reported as weight percentages multiplied by 10^{-4}, the concentration of the gases in the iron may then be conveniently stated as so many *parts per million,* which is a common method of measuring trace elements in chemistry. Thus, 2 mils. per 100 grms. of hydrogen at N.T.P. is equivalent to 0.00018 per cent. (density of hydrogen = 0.0899 grms. per litre) or a concentration in the iron of 1.8 parts per million. When the limits of accuracy of the gas estimation are taken into account, this may be expressed in round figures as 2 parts per million.

Where the total volume of gas obtained on vacuum fusion is given in the text, this refers to the volume of gas actually measured in the apparatus, which consists of carbon-monoxide (not oxygen), hydrogen and nitrogen. This volume is expressed in mls. per 100 grms. It is to be understood that this gas volume was made up of nitrogen and hydrogen from the iron sample and carbon-monoxide which may have been derived from the interaction of oxygen-bearing compounds in the iron sample with the carbon of the crucible. It may be, of course, that the carbon-monoxide was evolved, as such, from the sample during fusion; indeed, in some vacuum-fusion heating experiments which have been made at 600 deg. C., about one-third of the total volume of gas evolved from solid metal specimens was carbon-monoxide, the remainder being hydrogen. In support of this point of view it must be recognised that there is little microscopical evidence to suggest that appreciable amounts of oxide or silicate inclusions do exist in cast iron.[5] The Authors have, therefore, considered it proper to report total gas-content values found experimentally without attempting to justify the carbon-monoxide in terms of original oxygen content of the iron.

(7) The Effect of Storage on the Gas Content of Iron

The elusive nature of hydrogen in ferrous metals is well known. Steel may become charged with hydrogen on immersion in dilute acid, as in pickling. The slow escape of hydrogen gas at room temperature from the surface of pickled sheets may cause trouble in the tin-plate or canning industries; the more rapid escape of hydrogen at higher temperature may cause bubbles to form in vitreous-enamel coatings. Mild-steel as-cast bar frequently is super-saturated in respect of hydrogen and gas is slowly evolved at room temperature. This can readily be confirmed if a suitable small specimen of steel be confined in an inverted test tube over mercury, when a small gas bubble will develop at the top of the tube. Cast-iron specimens when so treated appear to be much less prone to evolve gas in the cold.

It is interesting to record that, from some fifty samples of cast iron of various types, only in four cases was any gas observed to form in the tube after a standing period of 4 weeks. During the same time, however, relatively large evolutions of gas from both "as cast" and rolled samples of steel could be detected. Moreover, the total gas evolved from steel was in considerably larger amounts than that found with the cast-iron specimens yielding gas. Typical results are summarised in Table I. In this Table the rate of gas evolved is given in mls. per hr. per gm. $\times 10^{-7}$. This notation has been adopted in this instance to bring the rates to whole numbers for ease of comparison.

It is perhaps noteworthy that with the cast irons used in these gas-evolution experiments, of the four specimens yielding traces of gas, two were white irons containing no free graphite, and two were silicon irons with only a limited graphite content. The ordinary grey irons did

TABLE I.—*The Evolution of Gas from Iron and Steel at Atmospheric Temperature and Pressure.*

Type of specimen and composition.	Time of immersion in hours.	Average rate of gas evolution, mls./hr./gm.
(1) Electric high-frequency-furnace melted steel "as cast"—inserted in apparatus 5 minutes after pouring	168 hrs.	$1{,}100 \times 10^{-7}$
T.C. 0.12 per cent.		
Si 0.14 ,,		
S 0.02 ,,		
P 0.07 ,,		
Mn 0.32 ,,		
(2) Rolled mild steel bar from stock	150 hrs.	$2{,}000 \times 10^{-7}$
T.C. 0.15 per cent.		
Si 0.22 ,,		
S 0.04 ,,		
P 0.11 ,,		
Mn 0.64 ,,		
(3) Electric-arc-furnace melted cast iron. White "as cast" in sand. Inserted in apparatus 5 mins. after pouring	240 hrs.	62×10^{-7}
T.C. 2.32 per cent.		
Si 1.04 ,,		
S 0.06 ,,		
P 0.10 ,,		
Mn 0.80 ,,		
Ni 3.87 ,,		
Cr 1.60 ,,		
Cu 0.15 ,,		
(4) Cupola-melted cast iron. Chill cast white. Tested after 6 days	200 hrs.	2.5×10^{-7}
T.C. 2.65 per cent.		
Si 1.84 ,,		
S 0.060 ,,		
P 0.52 ,,		
Mn 0.47 ,,		
(5) Cupola-melted cast iron. Chill cast white. Tested after 2 hrs.	300 hrs.	16×10^{-7}
T.C. 2.53 per cent.		
Si 2.00 ,,		
S 0.045 ,,		
P 0.19 ,,		
Mn 0.67 ,,		
(6) Electric high-frequency-furnace melted high-silicon iron. Tested after 5 mins.	300 hrs.	8×10^{-7}
T.C. 0.65 per cent.		
Si 14.9 ,,		
P 0.24 ,,		
Mn 0.54 ,,		
(7) Electric-arc-furnace melted high-silicon iron. Tested after 3 hrs.	300 hrs.	10×10^{-7}
T.C. 0.72 per cent.		
Si 13.9 ,,		
P 0.24 ,,		
Mn 0.39 ,,		

Residual Gases in Cast Iron

not appear to give off gas at ordinary temperature and pressure. The gas obtained from the specimens was in every case too small to analyse with the Ambler apparatus.

In view of the apparent stability of gases in cast iron at atmospheric temperature and pressure it was not surprising to find that every specimen of iron tested yielded substantial amounts of the three gases, hydrogen, carbon-monoxide, and nitrogen on vacuum-fusion analysis. In fact, when certain pig-irons made over twenty-five years ago were analysed, the hydrogen and oxygen percentages were found to be higher than in equivalent grades of recently made iron (from the same blast furnaces) tested three months after casting. These results are shown in Table II.

The original gas content of the 1920 pig-irons is not known. If, however, any change in hydrogen and oxygen occurred during storage in this instance, it was unlikely to be in the direction of loss of gas, unless, of course, the original gas content was very large.

Further evidence on the retention by iron of relatively large percentages of oxygen and hydrogen was afforded by the discovery of a very old furnace bear during an excavation in a slag bank. This old iron, which was completely embedded in slag, was in the form of an irregular lump weighing perhaps 15 cwts., and when broken it showed a very coarse fracture. A vacuum-fusion gas-analysis was carried out on two separate samples from the lump shortly after it had been unearthed, and one year later another sample was analysed. The results are given in Table III.

TABLE III.—*Gas Content of a Century-old "Bear."*

Gas analysis.	Original sample "A."	Original sample "B."	Sample "C" one year later.
Total volume, mls. per 100 gms.	46.0	32.1	33.6
Hydrogen	16.0	10.5	11.5
Oxygen	190.0	140.0	140.0
Nitrogen	20.0	10.0	15.0
In parts per million.			

The old furnace bear was known to be over 100 years old, and therefore the presence of high oxygen and hydrogen percentages would suggest that, under the conditions of burial, little loss of these gases had occurred. It is of interest that specimens broken from different parts of the lump gave different gas contents. When a specimen of the iron, roughly 2 in. cube, was left exposed to the air and was then re-sampled one year later for vacuum-fusion analysis, the hydrogen and oxygen contents still remained high. Owing to the initial heterogeneity in the lump of iron it was not possible to detect whether any change had acually taken place in the gas content during the time the sample had been exposed to air, but the change, if any, must have been of a very low order.

An experiment was made in which sand-cast and chill-cast bars were made from a common supply of molten iron contained in a sampling spoon. The sand-cast bar was 2 in. diameter × 12 in. long, and the chill-cast bar, made in a copper mould, was a pencil ¾ in. diameter × 4 in. long. The chill-cast bar solidified almost at once, and a specimen broken from it was inserted as quickly as possible into an inverted test tube over mercury so as to collect any gas that might be evolved. The whole operation took only two minutes. The sand-cast bar, on the other hand, was allowed to cool very slowly. Both types of specimen were then analysed some three days later for residual gases by the vacuum-fusion method, and identical results were obtained as given in Table IV. The chill-cast bar gave off no measurable amount of gas during the time it was confined over mercury.

TABLE IV.—*Gas Analysis of Chill-cast and Sand-cast Bars of Identical Composition.*

(*a*) *Percentage chemical composition of iron.*

T.C.	Si.	S.	P.	Mn.	Ni.	Cr.	Mo.	Cu.
2.93	0.85	0.147	0.45	0.30	0.11	0.06	0.25	0.14

(*b*) *Gas analyses.*

	Chill-cast pencil.	Sand-cast bar.
Hydrogen	1.5	1.5
Oxygen	25.0	25.0
Nitrogen	50.0	50.0
(Parts per million.)		

From the evidence presented in this section it is clear that the residual gases in solid cast iron at room temperature and pressure are not fugitive to the same degree as in steel. Vacuum-fusion analysis of cast iron, therefore, is thought to indicate with fair approximation the gases actually present in a given specimen of cast iron whenever the estimation be carried out. The complicating factor of loss of hydrogen at room temperature and pressure, present with freshly-forged or cast steel, does not appear to be important with cast iron. Loss of hydrogen at elevated temperatures does occur, however, with cast iron, and it is also strongly

TABLE II.—*Gas Content of Derbyshire Pig Irons Cast in* 1920 *and* 1945.

Grade of iron.	1920. Total volume gases.	1920. Hydrogen	1920. Oxygen	1920. Nitrogen	1945. Total volume gases.	1945. Hydrogen	1945. Oxygen	1945. Nitrogen
No. 1	13.3	3.5	50	30	10.1	1.5	50	20
No. 2	27.4	6.5	120	35	7.9	2.0	25	45
No. 3	11.2	4.5	40	10	15.9	3.0	70	30
Foundry 4	11.3	3.0	30	55	9.8	1.5	40	35
Grey forge	17.0	5.5	60	35	9.8	2.0	35	35
Forge 4	29.5	3.5	160	45	13.5	4.0	40	40
Silky	11.3	3.5	40	20	7.7	2.0	20	30

Gas contents recorded in parts per million.
Total gas volumes recorded in mls. per 100 gm. of iron.

suspected that this gas may diffuse from certain irons during prolonged treatment at room temperature *in vacuo*. This suspicion is based largely upon a practical experience described below and has not been adequately proved.

During the course of a vacuum-fusion experiment to determine the residual gases in specimens of commercial acid-resisting high silicon iron (14 to 16 per cent. Si), the prepared "slugs" were left in the apparatus under high vacuum (better than 0.0001 mms. of mercury) for over a week. Some of the specimens when examined showed surface spalling as shown in Fig. 7. When the residual gases in the specimens were subsequently determined the results were in no way abnormal, the change in hydrogen, oxygen or nitrogen being insufficiently marked to be detected with certainty. The initial hydrogen content of the most badly affected specimens was rather higher than normal.

(8) The Segregation of Gases in Cast Iron

It is difficult to devise an experimental technique which will follow the variations in the distribution of gases in solid iron with the ease that a sulphur print indicates segregation of sulphides. Solid inclusions of oxygen and nitrogen compounds in iron may, of course be detected microscopically as silicates, cyano-nitrides, etc., and the appearance of some of these is now familiar;[6] but hydrogen and carbon monoxide cannot be traced by the microscope. The vacuum-fusion apparatus can only work with specimens of iron weighing some grammes (10-20 gms. is a common weight of specimen), and therefore the investigation of micro-segregation by this means is impossible. A limited amount of work has been done, however, on macro-segregation of gases.

For work of this kind, sampling presents the greatest difficulty. One can seldom be certain that the correct location of the specimen has been chosen. Similarly, the possible loss of gas from small cavities in the iron, or due to overheating during sampling, all tend to vitiate the results. A notable difference in residual gas content from two parts of a single casting was found during an examination of a large cast-iron valve which had become badly eroded in one place during service. The results given in Table V show that large differences in oxygen and hydrogen existed in the eroded areas, and these differed substantially from the average gas content of the casting.

TABLE V.—*Example of Gas Heterogeneity in Cast Iron.*

	Sound samples.		Eroded samples.	
Hydrogen	4.5	4.0	9.5	8.5
Oxygen	160	160	280	580
Nitrogen	20	20	20	15
In parts per million.				
Total gas volume, mls. per 100 gm.	29.0	30.5	61.3	92.0

Although the eroded samples were carefully selected for freedom from obvious oxide inclusions and discontinuities, the iron was of much coarser grain and was less sound in these areas; the differences in gas content in this instance might, therefore, be due, not to segregation in the original casting, but to the influence of service conditions.

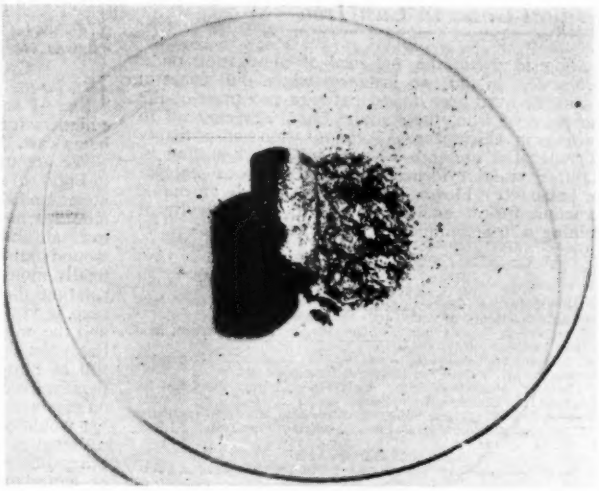


FIG. 7.—PHOTOGRAPH SHOWING SPALLING OF SILICON IRON AFTER STORAGE ON HIGH VACUUM.

The only other example of differences in gas content between two areas of the same casting is afforded by the old furnace bear to which earlier reference has been made. The two results "A" and "B," Table III, from the original lump of iron show marked differences in oxygen and hydrogen content. In this case, also, the grain size of the iron was abnormally large, and in view of the doubtful history of this iron, no conclusions can be drawn.

Abundant examples exist of vacuum-fusion experiments which have been made on different parts of the same cast of iron which have given identical results. Test bars are usually analysed in duplicate, and the gas-content determinations on castings taken at random have frequently checked up with results from test bars from the same ladle of iron. Different parts of the same piece of pig-iron have also been found to give substantially similar results, as shown in Table VI.

No conclusive evidence of segregation of gases in cast iron has been found in the work under review. The tests applied were not, however, sufficiently

TABLE VI.—*Triplicate Analyses from Samples Cut from One Pig of Hematite Iron.**

	Hydrogen.	Oxygen.	Nitrogen.
Sample 1 (from one end) ..	6.5	800	40
Sample 2 (middle)	5.5	750	35
Sample 3 (near other end)	6.0	790	35

* Results given in parts per million.

Residual Gases in Cast Iron

searching to detect the presence of segregation on a micro-scale. In the two instances where differences in gas content have been found between two parts of the same piece of iron, the samples had been exposed to conditions in which gaseous contamination had probably occurred. The presence of blow-holes in a casting is, of course, visual evidence of marked gaseous segregation, but badly "blown" metal is not readily amenable to vacuum-fusion analysis owing to the difficulty of obtaining a true sample.

(*To be continued.*)

REFERENCES.

1 Bibliography on Gases in Ferrous Metals. British Cast Iron Research Association. Available only to members on application.
2 W. C. Newell, Fourth Report of the Oxygen Sub-Committee, Iron and Steel Institute, July, 1943.
3 H. A. Sloman, Sect. IV, Sixth and Seventh Reports, Heterogeneity of Steel Ingots, Iron and Steel Institute, 1936 and 1937.
4 "Chemical Analysis of Iron," by Wesley-Austin. Published by British Cast Iron Research Association.
5 Fourth Report, Oxygen Sub-Committee, Iron and Steel Institute.
6 H. Morrogh, "Micrographical Examination of Cast Iron," J.I.S.I., 1939, No. II.

Publication Received

Molybdenum Steels, Iron and Alloys. By R. S. Archer, J. Z. Briggs and C. M. Loeb, Jnr. Published by the Climax Molybdenum Company of Europe, Limited, 2 & 3, Crosby Square, London, E.C.3.

Be the recipient of this well-groomed book a metallurgist, or practical foundryman, he will find therein recent data of the most illuminating character. The Table of Contents and the Index are alike excellent, and perhaps this is necessary for direct information on cast iron is given in Sections I, III and IX, whilst steel castings are referred to Sections I, II, III, VIII and X. Because of this, the value of the book is considerably enhanced, as the reader is thereby taught just how his own particular field of activity fits into the general survey of the complete subject. The founders of high-duty alloy cast irons will appreciate to the full Table 67, where throughout 18 pages are detailed the chemical compositions and resulting mechanical properties of alloys for about 180 different types of castings, all of which contain molybdenum. The corresponding tables (Nos. 58 and 59) for steel castings are somewhat differently treated. The first covers the tensile properties of normalised and tempered alloy cast steel and the second after quenching and tempering. These tables give details of many dozens of alloys ranging from 33 to 90 tons per sq. in., in order of increasing strength.

The appendices have been well chosen; they cover studies of the "S" curves; Jominy hardenability test; composition ranges for British and foreign engineering steels; conversion tables and analytical methods. Recipients of this 400-page, well-illustrated book can indeed count themselves fortunate, for no metallurgical textbook carries such a wealth of data on the subject of molybdenum alloys.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

CARDING MACHINE CASTINGS

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I have a problem in my foundry in which big cylinders for carding machines of textile machinery are being cast.

We are using the bottom-pouring method as shown in Fig. 1 (*a*) and (*b*). The cylinder is 40 in. high, 56 in. diameter, and the wall thickness is only ⅝ in. The core of the mould is made of a steel plate drum with holes drilled over all the surface and two layers of grassrope are wound outside, as shown in (*c*) and (*d*). The sand is finally moulded on the rope by means of a scraper by rotating the shaft of the steel drum. The sand we used is very coarse so that the gas may escape easily, and the moulds and cores are completely dried throughout. Yet the castings are found to be very poor, being full of blowholes in the upper portion. Pouring temperature is around 1,400 deg. C. and the teeming conditions are very favourable.

I would like to have some practical advice from your readers as to the locating of the gates and risers or other different method for pouring. Also, an indication of better methods to make the core would be appreciated, because the method we now use is very slow in production and very expensive, whilst the temperature for baking the core could not be raised materially, due to the grassrope inside the core.—Yours, etc.,

K. L. CHENG.

Tsingtao, China.
September 1, 1948.

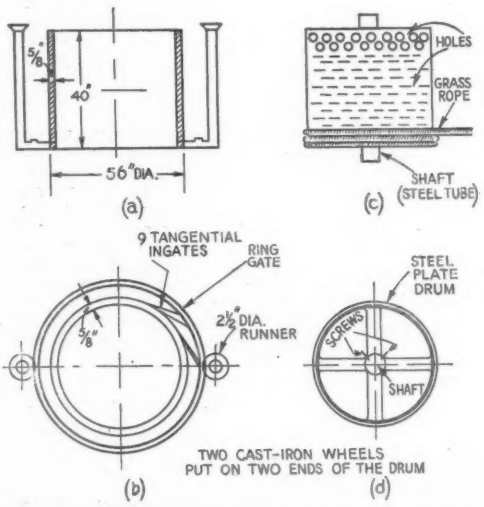


FIG. 1.—(*a*) AND (*b*), MOULD FOR CARDING MACHINE DRUM; (*c*) AND (*d*), CONSTRUCTION OF THE CORE.

Moulding and Casting a 5-ton Ingot Mould*

By J. Steele

A sketch of a 5-ton ingot mould is shown in Fig. 1 and it is proposed to give an outline of one method of making the core and mould for the casting. The finished weight of the casting is nearly five tons.

Core Sand

Very strict control is exercised over the preparation of the core sand, and each batch from the mill is tested for green permeability and green compression. At regular intervals, samples are baked in the laboratory oven for dry permeability and dry shear tests.

Using A.F.S. apparatus the following are the test figures aimed for in the core sand:—

Green permeability: 50 to 70.
Green compression: 8.0 to 10.0 lbs. per sq. in.
Dry permeability: 65 to 85.
Dry shear: 14 to 18 lbs. per sq. in.
Moisture content: 4.5 to 5 per cent.

*Winning entry in the Short Paper Competition organised by the Institute of British Foundrymen (South African Branch).

The moisture content is varied to suit the atmosphere; that is to say, on a hot day the sand will require to have a higher percentage of moisture than is required on a dry day. Due to the construction of the core, the moisture content must be carefully controlled, as, if the sand be too wet, it will stick to the corebox. On the other hand, if it be too dry, there is always the danger of the core dropping from the barrel.

Moulding Sand

The sand used for the mould is similar to that in use for the "Simpson" reclamation plant, using reclaimed iron moulding sand, new sand being added as required. This sand has properties not unlike those in use for general iron moulding, except that it is slightly weaker in the green state. The A.F.S. test results for this sand are as follows:—

Green permeability: 20 to 30.
Green compression: 9 to 11 lb. per sq .in.
Dry permeability: 40 to 50.
Dry shear: 12 to 18 lbs. per sq. in.
Moisture content: 5 to 6 per cent.

The Core

The core barrel with the core rammed up is shown in Fig. 2. The barrel A and base plate B are separate castings and are bolted together. Note the vent holes in the barrel at C and the lifting holes at D. The metal core box, which is in halves and bolted together, is shown in Fig. 3. To make the core, the box is

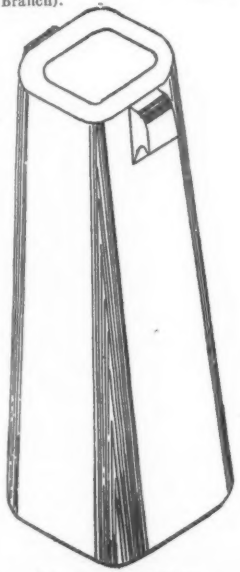


FIG. 1.—SKETCH OF FINISHED MOULD.

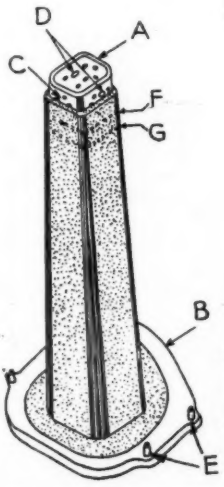


FIG. 2. — CORE-BARREL AND CORE RAMMED UP.

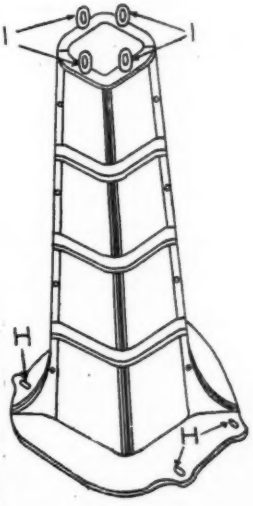


FIG. 3. — CORE-BOX ASSEMBLED FROM HALVES.

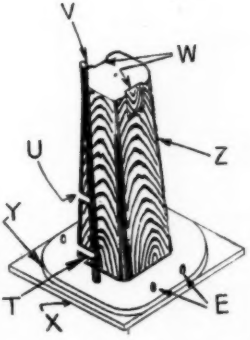


FIG. 4.—INGOT MOULD PATTERN.

Moulding and Casting an Ingot Mould

lowered over the barrel and holes H in the flange correspond with the locating pins E in the base plate (Fig. 2). Before ramming the core, the base plate is rammed with general iron moulding sand and struck off level with a straight edge.

The core is rammed by pneumatic rammer, and, provided the air pressure is constant, the first two feet of sand are given three rams; thereafter two rams are considered sufficient, the sand additions being made in regular quantities. During the ramming, two core irons are placed in position at points F and G as shown in Fig. 2. When the core has been rammed and scraped off, the box bolts are slackened, and, after rapping all round, by using the lifting eyes I (Fig. 3) the box is lifted vertically from the core.

This leaves a body of sand 2½-in. thick all round the barrel, and, by pushing a stout bar through holes D in the barrel, the core may be transported by crane to the core bogie where it is given a coat of blackwash, prior to being dried overnight at a controlled temperature which reaches a maximum of 300 deg. C.

The Mould

The ingot mould pattern is shown at Z (Fig. 4). In the same illustration, Y is the stripping plate and X the ramming up plate. The locations for the lugs are shown at W on the pattern. Fig. 5 indicates the construction of the cast-iron moulding box used for this mould. The pins E on the ramming-up plate locate the stripping plate and moulding box while ramming is in progress.

Before commencing to ram the mould, the downgate is placed in the position shown at V in Fig. 4. The ingates, U and T, are placed in position while the mould is being rammed. As with the core, the mould is rammed by pneumatic rammer. When the mould has been rammed and scraped off level, the downgate is withdrawn, and, by using the stripping apparatus shown in Fig. 6, the mould and stripping plate are lifted from the pattern and ramming-up plate. The mould is now placed on trestles, where the ingates are withdrawn and finished off. After the stripping plate has been removed, the mould is blackwashed and placed in the drying stoves, where the maximum temperature is 300 deg. C.

Gating

The method of gating the mould is shown in Fig. 4. The downgate V is 2½-in. dia. and the ingates T and U are 2-in. × 5-in. and 2-in. × 4-in. respectively. Ingate T is 6-in. from the bottom of the mould and U is 42-in. from the base. To avoid washing the core, both ingates run into the mould tangentially.

Closing

The closing of the mould offers no difficulty as the core base-plate and moulding-box bottom have machined surfaces. The closing, therefore, consists of dropping the mould over the core, ensuring that it is properly centred, and clamping the two parts together. The joint is now sealed, the runner box placed in position and the assembled mould, ready for casting, has the appearance shown in Fig. 7.

Casting

The metal is poured into the mould from a top-pouring ladle at an observed temperature of approximately 1,195 deg. C., and the average teeming time is 2 min. Due to the mould being cast open, the slag which rises to the top can be skimmed off and more metal poured into the head to fill the mould completely. The casting is left in the sand for a minimum period of 2¼ hrs., and as soon as convenient after this time, the stripping operation takes place.

On the following day the casting is fettled in the normal manner. The moulding and casting cycle takes two full days, and on the third day the moulding box and core barrel are in service again. The castings produced have a good surface finish and give a satisfactory teeming life before being scrapped. In conclusion, the author wishes to express his thanks to the management of Iscor, Pretoria, for permission to write and publish this Paper.

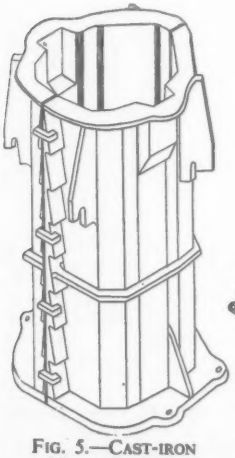


FIG. 5.—CAST-IRON MOULDING BOX.

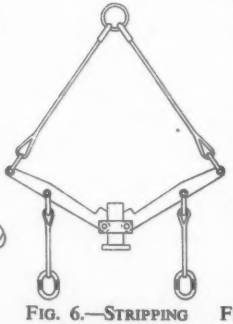


FIG. 6.—STRIPPING APPARATUS.

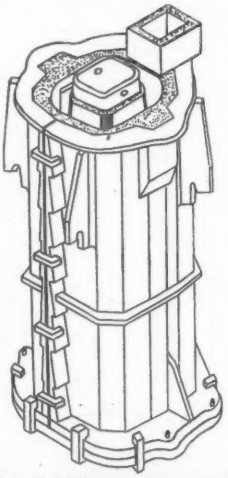


FIG. 7.—MOULD ASSEMBLED READY FOR CASTING.

THE INDEX TO VOLUME 84 of the JOURNAL, January to June, 1948, is now available, and may be obtained by writing to 49, Wellington Street, London, W.C.2.

The Foundry Trades' Equipment and Supplies Association

The Annual General Meeting was held at the Waldorf Hotel on October 19, Mr. W. Rawlinson presiding. The Annual Report was presented and adopted.

Annual Report

Membership.—The number of members of the Association on December 31, 1947, was 44, and represents no change from the previous year. There were 3 new members during the year ended December 31. 1947, 2 resignations, and one case of a merger between two members.

Accounts.—The Accounts showed an excess of expenditure over income of £65 3s. 10d., reducing the balance carried forward to £43 4s. 2d. The administration expenses of the Association for the year amounted to £395 18s. 10d., which compares with £366 10s. 8d. in 1946, and £530 19s. 8d. in 1945.

Handbook.—During the year copies of the Handbook "British Foundry Plant and Supplies" were distributed to a large number of foreign foundries and other interested concerns.

Exhibitions.—A number of members exhibited in the Foundry Trades Section of the Engineering and Marine Exhibition held at Olympia during the period August 28 to September 13, 1947, and thanks are due to the Exhibition Standing Committee for their services in negotiating with the organisers to secure the most convenient arrangements. Comments received have indicated that the Exhibition was considered successful, but a number of suggestions were made regarding possible improvements in future.

At the Annual General Meeting held on September 4, 1947, the Council was requested to obtain the views of members as to the location of exhibitions, the pros and cons of allying a Foundry Trades Section with a large Exhibition such as the Engineering and Marine Exhibition, and the best hours for exhibiting. The Council was requested to make recommendations based on the consensus of opinions of members so obtained. A meeting of the Council was held to consider the replies received, with the result already communicated to members that the Association has decided not to take part in the Engineering and Marine Exhibition in 1949, when the Annexe at Olympia will not be available, but to hold a Foundry Trades Section in the Annexe in conjunction with the next Engineering and Marine Exhibition in 1951.

Engineering Advisory Council.—A communication was sent to the Engineering Advisory Council of the Ministry of Supply, suggesting that the Association should be represented on that Council. This was stated to be impossible, owing to the limited number of seats on the Council, but the Association has received reports of the deliberations of that body, which have been circulated to members.

Census of Production.—Mr. R. H. Brackenbury has served as the Association's representative on a Joint Committee on Census of Production, and reports of the meetings of this Committee have been circulated to members.

Negotiations with Government Departments.—Throughout the year close co-operation was maintained with the Foundry Equipment Export Group, in negotiating with Government Departments in respect of export policy and the allocation of materials, and members have been kept informed on these subjects. While the present position relative to allocation of materials cannot be considered entirely satisfactory, it is felt that the efforts made have been beneficial.

The Report is signed by Mr. W. Rawlinson, *President,* and Peat, Marwick, Mitchell & Company, *Secretaries.*

Election of Council

The following Members were elected to the Council for the ensuing year:—Mr. W. E. Aske (William Aske & Company, Limited); Mr. R. H. Brackenbury (Sterling Foundry Specialties, Limited); Mr. V. C. Faulkner (FOUNDRY TRADE JOURNAL); Mr. C. Orton Foster (British Foundry Units, Limited); Mr. G. E. France (August's, Limited); Mr. T. A. Hammersley (Marco Conveyor & Engineering Company, Limited); Mr. D. Cherry Paterson (Paterson Hughes Engineering Company, Limited); Mr. W. Rawlinson (J. W. Jackman & Company, Limited); Mr. A. C. Turner (General Refractories, Limited); Mr. D. H. Wood (The Constructional Engineering Company, Limited).

Charles Comins & Company were re-appointed auditors.

The President, Mr. W. Rawlinson, drew attention to the efforts being made by the Government to increase production efficiency, and made an appeal to the members to see that everything possible was done in their own organisations to this end. The question whether any helpful steps might be taken by the Association as a whole was referred to the Council for consideration.

A discussion took place with regard to the interests and problems of Supply Company members as distinct from the Equipment Company members, and satisfaction was expressed that the Supply members now had a *pro rata* representation on the Council.

The A.I. Train *en route*

Last Saturday, the Allied Ironfounders' Exhibition train arrived at Ketley, Shropshire, where it was inspected by the operatives of the company's local works. The canteen was used for a cinema show, and a marquee was erected for providing the guests with light refreshments. The works also were open for inspection by wives and families. It is estimated that about 650 persons were admitted to the train and about 450 were shown over the works. Normal operations in the large mechanised foundry were demonstrated for the benefit of the visitors.

Book Reviews

Metalwork. By Donald Smith. Published by B. T. Batsford, Limited, 15, North Audley Street, London, W.1. Price 7s. 6d. net.

There are nine chapters in this book and each one terminates with a list of "things to do." Most of these are of a practical character, yet the ultimate object, it can be presumed, is to acquire a reliable historic knowledge of the articles covered. The reviewer has not the pretensions of an antiquarian and most of the matter printed breaks new ground for him. Of the two things of which he has knowledge, however, he finds himself at variance with the author. The first case refers to table forks; the author states that "forks had only two prongs until the eighteenth century, and carving forks still have but two. The fourth prong was added within the last forty years." The reviewer can assure the author that the four-pronged forks now in use at his home are at least sixty years old. The second statement to which objection is taken: "Actually the Stone Age has never ceased . . . most useful little flint and steel 'lighters' are still sold for use on gas stoves." The "flint" in this case is not "flint" but ferro-cerium, and is the result of scientific research. It is a pity these inaccuracies were printed, for, whilst the chapters on the blacksmith, the goldsmith, the dinner table, lighting and heating make fascinating reading, there remained a wonder as to reliability. The illustrations are at the "Batsford" level, which is indeed high praise.

Ferrous Materials for the Engineer. By Reginald Fox. Published by Charles Griffin & Company, Limited, 42, Drury Lane, London, W.C.2. Price 12s. 6d.

The reviewer is a little perplexed as to meaning of the title of this book. It could be interpreted either as a medium for enlightening the engineer as to the properties and potentialities of the ferrous materials he uses, or a textbook covering the nature of the materials indicated. If the object was the former, then before judgment could be passed it would be necessary to define an "engineer," and appraisal would vary accordingly. For instance, the mechanical engineer would find a study of the B.S.I. specification for cast iron (No. 1452—1948) of infinitely more use than Table XII of the book, as he is interested in strength related to section, but will not miss much by ignoring the existence of mottled iron. Again, special cast irons should not be dismissed in four lines, even though a long table is included. Such information as is given is liable to cause the engineer to specify the wrong type of material.

If the second suggestion—a statement of the properties of ferrous materials—be the object of the book, then it is somewhat more satisfactory, as information is given under four headings: General Properties of Materials; the Testing of Materials; the Heat-treatment of Steel and the Materials Available. The whole book has undoubtedly suffered from over compression, and occasional laxity in expression, as, for example, on page 145, when the word "mould" is used instead of "pattern." V. C. F.

Publication Received

Stanton at War, 1939-45. Published by the Stanton Ironworks Company, Limited, near Nottingham.

It is a moot point as to whether industrial history should be presented virtually contemporaneously or whether there should be a decent lapse of time to get everything into a proper perspective. The former method usually carries more glamour, whilst the latter tends to be factual, and essentially orderly. The subject matter of the Stanton book covers all the various departments, transport, A.R.P., Home Guard, Welfare, and Medical. The story starts with the creation of the Stanton Gate Foundry, which the reviewer would designate as the best equipped mechanised steel foundry the world has ever seen. It has received, as it well merits, quite a lengthy semi-technical description. Our readers are familiar with this plant as it was the subject of a Paper read before the Institute of British Foundrymen by Mr. P. H. Wilson, O.B.E. Thus the reviewer found the description of the work done in the other foundries belonging to the Stanton concern of real interest. Though in the dim past Stanton were interested in armaments, they have for many years been essentially a concern making peacetime products, and their war-time effort was indeed outstanding. The illustrations are of a high order, but their presentation seems to have been just a little too geometrical. The outstanding picture is one of the blast-furnace casting during the night. The binding has been carried in dark green, with the title printed in gold lettering on a black background, and taking the form of a square medallion. The effect is particularly pleasing.

House Organs

Albion Works Bulletin. Vol. 2. No. 9. Issued by John Harper & Company, Limited, Albion Works, Willenhall, Staffs.

This issue, apart from the usual accounts of sports activities and the like, reports a talk by Mr. J. Bamford, B.Sc., the head of the National Foundry College, to the Joint Production Committee.

Winget Life, Autumn 1948. Published by Winget, Limited, Rochester, Kent.

The reviewer has had reason to criticise certain issues of Winget Life in the past, but he is full of admiration for the current issue. As is well-known, this company has stressed for a long time the importance of joint consultative committees. Now, through this issue, the employees have presented to them, in a form they can readily understand, the financial make-up of the concern for which they work. This has been done by photographing the actual coins going into the purchase of raw materials, wages, operating expenses, depreciation, taxation and dividends. There is a well illustrated account of the opening of the new sports ground, in addition to a *résumé* of all the various committee meetings.

Future of Individual Enterprise

Need for Concerted Action

"There can be no doubt that the most grave and urgent problem, both in its immediate and long-range effects, with which manufacturers are confronted, is the future of individual enterprise," said Sir Patrick Hannon, M.P., president of the National Union of Manufacturers, in initiating a conference on private enterprise at the annual meeting of the Union in London recently. "For good or ill, we as manufacturers have to face a future in which all the essential factors of our activities will probably be controlled by the State, whatever the political colour of our Government. In plain terms, this means that the Government of the day will possess a complete stranglehold on all the essential factors of our production. Therefore, the manufacturer is vitally concerned as to the price, quality and availability of the State controlled or operated goods and services. It will be obvious that they affect his ability to compete in world markets or to produce his goods at an economic price for the home market. Our very survival depends on the efficiency of State-controlled industries and on industry being able to secure adequate supplies at reasonable prices."

Sir Patrick said that individual enterprise as represented by manufacturers was the only great and vital force in this country which remained inadequately organised. There were some 40,000 substantial manufacturers in Great Britain. "We have to admit with keen disappointment that after all the work that has been done over the years, not more than some 15 per cent. are in membership of any national body." How different was the position of their Canadian colleagues where roughly 95 per cent. of the manufacturers were members of the Canadian Manufacturers' Association.

The meeting adopted a resolution reaffirming its belief in free enterprise and instructing the administrative committee, in consultation with the branches of the Union, to consider what steps could best be taken for the preservation and encouragement of free enterprise.

Mr. Bevin on Industrial Relations

The Foreign Secretary (Mr. Ernest Bevin), who also addressed the meeting, said: "I ask the manufacturers of this country never to forget that we are 50 years ahead of the world in the handling of industrial affairs as between capital and labour. It is the one country in the world to prevent all serious industrial disturbances since the war closed, and I know of nothing which has enhanced the industrial prestige of Great Britain more than the understanding that has been arrived at in industrial development since the end of the war."

Continuing, Mr. Bevin maintained that unless in crises governments could curb their appetites for high prices, so long would the world remain unstable. The great thing governments had to do to-day was to teach their citizens that, at moments of financial and commodity crises, appetites must be curbed and prices regulated in order to restore equilibrium at the earliest possible moment.

Personal

MR. J. ANGUS ORR has joined the board of the British Engine Boiler & Electrical Insurance Company, Limited.

MR. HERBERT R. BEAUCHAMP has been appointed a director of Scottish Non-Ferrous Tube Industries, Limited.

LT.-COL. R. D. HESELTINE has been appointed to the South Wales local board of Dawnays, Limited, structural engineers.

MR. H. F. MASSEY has resigned from the board of B. & S. Massey, Limited, manufacturers of steam and power hammers, etc., of Manchester.

DR. P. F. SOPER, head of the electrical engineering department of Doncaster Technical College, is taking up a similar post at Nottingham's new technical college in January.

DR. FRANK ADCOCK, Professor of Metallurgy at the Indian Institute of Science, Bangalore, has been appointed to take charge of research for the Broken Hill Proprietary Company, Limited.

MR. H. A. PRICE-HUGHES, manager of the publicity department of the British Thomson-Houston Company, Limited, retires at the end of this month, after 44 years' service with the company. He is succeeded as manager by his deputy, MR. C. H. CHAPLAIN.

MR. THOMAS MEEHAN, North-East Divisional Officer of the Iron and Steel Trades Confederation, is to receive the freedom of his native town, the County Borough of Middlesbrough. He has been continuously a member of the local Town Council since 1921.

MR. F. E. MAER, works director, and MR. W. ANDERSON, foundry manager, of the Glacier Metal Company, Limited, Alperton, Middx, sailed for the United States yesterday (Wednesday). They will study industrial, technical and managerial methods there.

MR. E. S. WADDINGTON, of the industrial department of Philips Electrical, Limited, has been re-elected vice-chairman of the Finance Committee of the Institute of Welding. He has also been elected vice-chairman of the B.E.A.M.A. resistance welding machine section.

MR. JAMES PATTON, a director and general manager of Smith's Dock Company, Limited, North Shields, has been elected president of the Cleveland Technical and Scientific Institute, in succession to MR. J. H. PATCHETT, general manager of the Redcar works of Dorman, Long & Company, Limited.

MR. BENINK and MR. R. ADDIE, of Mullard Electronic Products, Limited, left London on October 16 for a six-week sales promotion and inspection tour of the company's overseas organisation. The trip will include visits to Egypt, Siam, India, Pakistan, Ceylon, and the Federated Malay States.

PROF. M. L. E. OLIPHANT, Professor of Physics at Birmingham University, has been appointed director of post-graduate research in the school of physical sciences at the National University of Australia. He will not take up his duties until suitable laboratories have been erected and equipped and housing provided for the staff and the university established as a working body. Meanwhile, he will continue to advise the university on the steps to be taken to establish a research school of physical sciences in Canberra.

Pig-iron and Steel Production in Great Britain

The following particulars of pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for September, 1948, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in August, with the number of furnaces in blast at the end of the month; Table II, production of steel ingots and castings in August, and Table III, deliveries of non-alloy and alloy finished steel. Table IV summarises steel-industry activities during the six months ended August, 1948.

TABLE I.—*Weekly Average Production of Pig-iron and Blast-furnace Ferro-alloys, August*, 1948. (*Thousands of Tons.*)

District.	Furnaces in blast, 28.8.48	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants, and Essex	26	—	15.0	21.3	2.0	—	38.3
Lancs. (excl. N.-W. Coast), Denbigh, Flints. and Ches. / Yorkshire (incl. Sheffield, excl. N.-E. Coast)	6	—	6.3	—	—	1.3	7.6
Lincolnshire	14	—	22.7	—	—	—	22.7
North-East Coast	25	7.4	34.9	0.4	—	1.4	44.1
Scotland	9	0.7	11.7	2.7	—	—	15.1
Staffs., Shrops., Worcs., and Warwick	8	—	7.9	1.2	—	—	9.1
S. Wales and Monmouthshire	8	3.4	19.5	—	—	—	22.9
North-West Coast	6	14.0	—	—	—	0.2	14.2
Total	102	25.5	118.0	25.6	2.0	2.9	174.0
July, 1948	101	26.4	113.5	26.2	1.8	3.4	171.3
August, 1947	95	21.6	96.7	25.7	1.1	2.1	147.2

TABLE III.—*Weekly Average Deliveries of Non-alloy and Alloy Finished Steel.* (*Thousands of Tons.*)

Product.	1947 (53 weeks).	1948 (1st 8 months).	1947. Aug.	1948. July.	1948. Aug.
Non-alloy Steel :—					
Heavy rails and sleepers	7.6	8.6	7.0	7.1	7.4
Heavy and medium plates	31.6	35.1	28.5	26.5	29.9
Other heavy products	31.8	34.2	30.5	27.9	29.0
Light rolled products (excl. wire rods and alloy-steel bars)	49.7	54.6	45.6	46.3	50.2
Ferro-concrete bars	3.2	3.8	3.0	3.6	3.5
Cold-rolled strip	4.6	4.6	4.5	4.2	4.3
Bright steel bars	4.8	5.9	4.3	5.4	5.4
Sheets, coated and uncoated	24.3	25.9	19.4	25.5	21·6
Tin, terne and blackplate	12.1	13.4	8.7	14.0	10.4
Tubes and pipes	13.5	14.5	13.0	14.4	12.4
Wire	10.8	12.2	9.9	10.6	12.2
Tyres, wheels and axles	3.5	3.7	2.9	3.4	3.6
Forgings	5.0	5.6	5.0	4.5	5.1
Castings	3.0	3.4	3.4	3.0	3.3
Total	205.5	225.5	185.7	196.4	198.3
Alloy Steel :—†					
Tubes and pipes	0.3	0.4	0.3	0.3	0.2
Bars, sheets, strip and wire	3.7	4.5	3.6	3.9	4.0
Forgings	1.8	2.3	1.8	1.9	2.4
Castings	0.6	0.6	0.6	0.5	0.6
Total	6.4	7.8	6.3	6.6	7.2
Total U.K. production‡	211.9	233.3	192.0	203.0	205.5
Less Inter-industry conversion	19.2	27.0	14.2	21.8	26.3
Total U.K. deliveries	192.7	206.3	177.8	181.2	179.2
Add deliveries of imported finished steel	2.2	2.7	—	2.9	2.8
Total deliveries of finished steel	194.9	209.0	177.8	184.1	182.0

† Excludes high-speed steel.
‡ Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.

TABLE II.—*Weekly Average Production of Steel Ingots and Castings, August*, 1948. (*Thousands of Tons.*)

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants and Essex	—	—	(Basic) 9.9	0.9	0.2	10.5	0.5	11.0
Lancs. (excl. N.-W. Coast), Denbigh, Flints., and Ches. / Yorkshire (excl. N.-E. Coast and Sheffield)	1.5	18.1	—	1.0	0.3	20.1	0.8	20.9
Lincolnshire	—	30.2	—	—	0.1	30.2	0.1	30.3
North-East Coast	0.9	53.4	—	0.8	0.4	54.1	1.4	55.5
Scotland	4.9	37.6	—	2.1	0.6	43.8	1.4	45.2
Staffs., Shrops., Worcs. and Warwick	—	11.7	—	0.6	0.7	11.8	1.2	13.0
S. Wales and Monmouthshire	9.2	34.6	(Basic) 5.6	0.7	0.1	49.9	0.3	50.2
Sheffield (incl. small tonnage in Manchester)	8.1	23.4	—	6.6	0.6	37.0	1.7	38.7
North-West Coast	0.3	1.8	(Acid) 4.4	0.1	0.1	6.6	0.1	6.7
Total	24.9	210.8	19.9	12.8	3.1	264.0	7.5	271.5
July, 1948	21.4	178.1	18.9	11.2	2.8	226.2	6.2	232.4
August, 1947	22.9	179.5	17.9	10.8	3.1	227.5	6.7	234.2

(*Continued at foot of facing page.*)

Frustrated Exports

The Board of Trade, in consultation with the Central Price Regulation Committee, has made the Miscellaneous Goods (Frustrated Exports) (Maximum Prices) Order, 1948, which came into operation on Monday. The Order is required in connection with the scheme under which certain goods, for which markets cannot be found abroad, are now being released on the home market with the approval of the Board of Trade. Where the goods are released while they are still owned by the manufacturer, they are covered by the ordinary price control Orders throughout, subject to any conditions which may be imposed in individual cases; but, where release is granted when the goods have already passed to an exporter, special price control provisions are required and it is these provisions that are contained in the new Order.

The Order applies to goods conforming to the definition of "frustrated exports" contained in the Order. These are price-controlled goods (*a*) which an exporter has bought intending at the time of purchase that they should be exported; (*b*) the export of which has become impracticable, and (*c*) for which the Board of Trade has issued a certificate that export is impracticable and that the supply on the home market is in the public interest. The Order fixes maximum prices for such certificated goods on sale by an exporter, wholesaler, distributor or retailer.

The Price Controlled Goods (Frustrated Exports) (Restriction of Resale) Licence, 1948, which also came into operation on Monday, authorises an exporter to whom the certificate has been granted and a wholesaler buying from him to re-sell "frustrated exports" covered by the certificate otherwise than by retail.

Mr. F. Scopes's Appointment

At a recent meeting of the Joint Iron Council Executive Committee, Mr. F. Scopes, managing director of the Stanton Ironworks Company, Limited, was elected president for the ensuing year. Mr. FitzHerbert Wright, chairman of the Council of Ironfoundry Associations, was elected vice-president.

Calcutta Firms Amalgamate

Following a process of reorganisation and primarily to ensure continuity of management, the old-established firms of Burn & Company, Calcutta, and Martin & Company, Calcutta, have been dissolved, and the assets and goodwill of these two firms have been acquired by Martin Burn, Limited, Calcutta, a company formed expressly for that purpose. The business previously carried on by the two firms in India will continue to be carried on by Martin Burn, Limited, and, in particular, the various companies previously managed by the two firms will now be managed by Martin Burn, Limited. The London office of T. A. Martin & Company, under the scheme, becomes automatically a part of the Martin Burn organisation, as that company has acquired and will take over the goodwill and obligations of T. A. Martin & Company, which will therefore, in future, operate from Martin Burn House, 71, Queen Street, London, E.C.4, but under the name of Martin Burn, Limited (London Agency).

Anglo-U.S. Productivity Council

The first meeting of the Anglo-American Council on Productivity was held on Monday, when questions of procedure and organisation were considered. There was also a discussion on investment in modernisation of plant and equipment. Mr. Stanley A. Holme, joint secretary for the U.S. section of the Council, had previously had discussions with the U.K. joint secretaries about the programme of work for the Council. Further meetings of the Council are being held this week.

Separate meetings will be arranged as required to enable the specialist advisers to make appropriate contacts with British interests, on subjects of concern both to employers and to trade unionists. The Americans will devote as much time as possible to paying visits to factories in various parts of the country.

RANSOMES & RAPIER, LIMITED, has had the walls of its Waterside Works, Ipswich, plastered and treated with special high-gloss paint to prevent the adherence of foundry dust.

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN (*Continued from previous page.*)

TABLE IV.—*General Summary of Pig-iron and Steel Production.* (*Weekly Average in Thousands of Tons.*)

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy).			
						Imports.‡	Output of ingots and castings.	Deliveries of finished steel.	Stocks.†
1938	228	89	—	130	118	16	200	—	—
1946	234	115	169	149	147	8	244	192	1,068
1947 (53 weeks)	209	130	165	147	145	8	240	195	797
1948—March*	243	169	192	179	175	7	291	219	780
April	247	169	200	181	178	7	294	229	793
May	230	173	202	184	175	4	293	205	846
June*	257	171	206	181	180	8	297	223	886
July	253	156	201	171	144	7	232	184	990§
August	233	163	200	174	162	6	271	182	984

* Five weeks. † Stocks at end of years and months shown. ‡ Weekly average of calendar month. § Revised.

Imports and Exports of Iron and Steel

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in September, and the first nine months of 1948. Figures for the corresponding period of 1938 are given for purposes of comparison.

Total Exports of Iron and Steel

Destination.	September, 1948.	Nine months ended September.	Three-quarters of 1938.
	Tons.	Tons.	Tons.
Eire	5,259	53,121	41,790
Channel Islands	992	7,859	5,562
Gibraltar	227	2,347	663
Malta and Gozo	692	3,776	1,728
Cyprus	332	2,912	1,242
Palestine	134	12,206	6,054
British West Africa	4,099	32,444	37,308
Union of South Africa	11,310	107,151	173,316
Northern Rhodesia	1,481	8,159	15,432
Southern Rhodesia	4,176	19,722	27,159
British East Africa	7,389	50,906	19,449
Bahrein, Koweit, Qatar and Trucial Oman	1,306	21,888	*
India, Pakistan, etc.	7,498	59,923	119,010
British Malaya	4,482	23,412	49,938
Ceylon	1,336	9,514	19,524
North Borneo	23	8,602	87
Hong Kong	3,248	25,602	17,697
Australia	7,486	54,758	128,178
New Zealand	6,868	46,036	98,913
Canada	3,030	18,182	64,056
British West Indies	4,495	27,473	33,189
British Guiana	328	3,492	2,247
Anglo-Egyptian Sudan	842	7,469	6,219
Other British countries	3,204	14,359	10,488
Russia	2,447	15,566	3,261
Finland	5,247	55,758	13,206
Sweden	7,361	73,754	8,982
Norway	5,618	47,258	15,204
Iceland	420	3,794	495
Denmark	7,820	59,587	65,442
Poland	175	1,612	1,866
Netherlands	6,797	62,311	38,670
Belgium	787	8,435	15,243
France	1,344	12,640	10,041
Switzerland	718	13,226	2,085
Portugal	1,608	18,132	5,784
Spain	676	4,935	5,823
Italy	185	3,727	3,855
Hungary	119	881	24
Czechoslovakia	106	342	1,737
Greece	621	3,055	1,314
Turkey	5,124	16,698	10,317
Dutch East Indies	2,322	18,445	20,481
Dutch West India Islands	544	5,973	1,848
Belgian Congo	105	1,000	228
Algeria	8	615	39
Portuguese East Africa	376	2,038	10,665
Syria	87	2,473	1,953
Lebanon	1,696	8,659	
Egypt	3,089	34,595	25,806
Iraq	2,039	37,945	19,305
Iran	3,951	78,591	82,785
Burma	772	20,848	13,884
Siam (Thailand)	228	1,911	4,497
China	312	13,021	16,884
U.S.A.	2,810	5,348	1,641
Cuba	57	1,715	543
Colombia	105	5,280	2,868
Venezuela	6,838	42,160	3,507
Ecuador	30	1,841	1,194
Peru	69	2,554	2,274
Chile	203	7,368	4,719
Brazil	1,826	13,785	12,744
Uruguay	473	6,311	5,691
Argentine	11,560	75,977	59,517
Other foreign countries	2,198	22,861	61,235
Total	169,058	1,434,338	1,436,906

* Included in "Other British countries" and "Other foreign countries."

Total Imports of Iron and Steel

From	September, 1948.	Nine months ended September.	Three-quarters of 1938.
	Tons.	Tons.	Tons.
Australia	—	11,593	27
Canada	5,427	58,403	88,032
Other British countries	1,264	4,420	120,924
Sweden	1,265	11,554	67,347
Norway	4,065	23,476	25,332
Germany	756	3,659	72,000
Belgium	30,741	109,319	205,260
Luxemburg	1,237	9,376	43,950
U.S.A.	4,718	86,056	150,519
Other foreign countries	8,994	43,172	234,831
Total	58,467	361,028	1,008,203
Iron ore and concentrates—			
Manganiferous	—	28,041	46,713
Other sorts	738,954	6,716,539	3,826,404
Iron and steel scrap and waste, fit only for the recovery of metal	95,155	535,634	474,153

Exports of Iron and Steel by Product

Product.	September, 1948.	Nine months ended September.	Three-quarters of 1938.
	Tons.	Tons.	Tons.
Pig-iron	95	690	70,455
Ferro-alloys, etc.—			
Ferro-tungsten	26	658	387
Spiegeleisen, ferro-manganese	84	2,597	3,897
All other descriptions*	62	563	786
Ingots, blooms, billets and slabs	194	4,424	7,308
Iron bars and rods	604	4,537	2,397
Sheet and tinplate bars, wire rods	486	3,307	11,676
Bright-steel bars	1,717	16,750	4,941
Other steel bars and rods	10,186	82,679	76,509
Special steel	1,336	14,188	3,699
Angles, shapes and sections	8,453	66,298	50,154
Castings and forgings	352	4,266	1,215
Girders, beams, joists and pillars	1,725	15,548	25,104
Hoop and strip	3,871	28,966	28,032
Plates, ¼ in. thick and over	11,258	90,842	98,226
Black plates	—	38,738	10,905
Black sheets	9,852	35,695	47,634
Galvanised sheets	10,694	63,401	110,202
Tinplates	15,966	140,610	239,490
Tinned sheets	417	3,567	1,059
Terneplates	—	118	3,243
Decorated tinplates	224	1,060	3,276
Other coated plates	190	2,704	168
Cast-iron pipes, up to 6-in. dia.	5,948	48,052	36,696
Do., over 6-in. dia.	3,836	40,426	32,223
Wrought-iron tubes	19,890	219,168	164,979
Radiators and central-heating boilers	228	2,497	3,021
Railway material	20,358	139,373	118,617
Wire	4,021	29,543	41,388
Cable and rope	2,095	20,605	12,300
Netting, fencing and mesh	1,465	13,193	7,062
Other wire manufactures	1,164	6,259	2,754
Nails, tacks, etc.	662	5,460	2,856
Rivets and washers	770	6,297	6,402
Wood screws	228	3,292	1,884
Bolts, nuts and metal screws	1,869	16,295	13,179
Stoves, grates, etc. (excl. gas)	1,020	8,950	5,256
Do., gas	260	2,200	1,608
Sanitary cisterns	113	1,167	2,109
Fencing material	125	2,420	3,849
Anchors, etc.	511	6,984	4,752
Chains, etc.	618	6,833	4,719
Springs	761	4,857	2,949
Hollow-ware	6,937	57,323	8,028
All other manufactures	18,387	170,938	159,518
Total	169,058	1,434,338	1,436,906

* The figures for 1938 are not completely comparable with those for subsequent years.

News in Brief

AN EXTRA-ORDINARY MEETING to alter articles for the re-election of directors of the Wombwell Foundry & Engineering Company, Limited, will be held at Sheffield on November 9.

HIGH DUTY ALLOYS, LIMITED, Slough, Bucks, announces that the price of all aluminium alloy extrusions, tube and wire sold by the company has been increased by 1d. per lb.

IT IS REPORTED that Mavor & Coulson, Limited, coal-conveyor and cutter manufacturers, of Glasgow, is to occupy the new factory which is being erected at Rutherglen by Scottish Industrial Estates, Limited.

APPROXIMATELY £300,000 is to be raised by issues of preference and ordinary shares by John Dale, Limited, manufacturers of tin boxes and collapsible tubes, etc., of New Southgate, London, N.11. Meetings are called for November 10.

A RECORD ORDER valued at £2,000,000, has been placed by South African Railways with the North British Locomotive Company, Limited, Glasgow, and the General Electric Company, Limited, Birmingham, for 40 main-line electric locomotives.

F. PERKINS, LIMITED, Peterborough, has bought the remainder of the site of the old Queen Street Ironworks in the centre of the city. A large part of the site has for several years been used by the company as one of its Diesel-engine factories.

THE INFORMATION SECTION of the Department of Scientific and Industrial Research has removed to Rex House, Regent Street, London, S.W.1 (telephone: Whitehall 9788). For the time being the remainder of the headquarters of the D.S.I.R. will remain at 24, Rutland Gate, S.W.7.

SCOTLAND is to have three additional district advisory committees of the Scottish Board for Industry covering the south-west, Inverness and the north, and Fife. Mr. Richard B. Lamb, a director of Cochran & Company Annan, Limited, boilermakers, has been appointed chairman of the south-west committee.

THOS. W. WARD, LIMITED, has purchased the buildings, plant and machinery of the Brighouse firm of Woodhouse & Mitchell, Limited. It is stated that as a result of the deal, Thos. W. Ward will manufacture machine tools, spot welders and other machinery of similar types for the first time in its history.

THE DUKE OF EDINBURGH was admitted to the Freedom and Livery of the Worshipful Company of Shipwrights at a special Court of the Company held at the Mansion House last week. At the same meeting the Prime Warden presented to Apprentice John H. Blyth, of the Burntisland Shipbuilding Company, Limited, the medal given by the King to the winner of the first prize (held for a period of three years) in the Company's prize scheme for apprentices.

AN EXTRA-ORDINARY MEETING of the Leeds Fireclay Company, Limited, has been called for November 5, to be held immediately after the annual meeting, to consider a special resolution to adopt new articles of association. Among new proposals is one to vary the power to borrow by providing that the aggregate amount borrowed by the company and all its subsidiaries is not to exceed the aggregate amount of the nominal capital of the company and its subsidiaries for the time being issued.

DEVELOPMENTS in the application of high vacuum to the melting and other heat-treatment processes of metals are presaged by an agreement between Birlec, Limited, Birmingham, and British American Research, Limited, Glasgow. The latter is the British associate of the National Research Corporation of America, whose work in the field of high vacuum in industry is universally known. Birlec, Limited, is equally well known in the sphere of industrial electric-furnace equipments for heat-treatment and melting.

AN "INDUSTRIAL FORUM" will be held at Long Eaton on November 4 and broadcast from 7.45 to 8.30 p.m. in the Midland Home Service. The chairman will be Sir George Schuster and there will be a panel of four speakers to reply, without advance notice, to questions put from the public audience. The speakers will represent management, trade unions, shop stewards and the North Midlands Board of Industry. It is felt that such public ventilation of industrial questions should help to promote mutual understanding and so aid production.

A REPORT on the market for agricultural tractors and machinery in India, compiled by the United Kingdom Trade Commissioners in India, stresses the importance of U.K. manufacturers being adequately represented in India. The Board of Trade suggests that firms not already represented which are desirous of entering the Indian market should forward six sets of catalogues, price lists, and agency terms to the Export Promotion Department, Thames House North, Millbank, London, S.W.1, for transmission to the U.K. Trade Commissioners in India for the names of firms suitable to undertake their representation.

Douglas (Kingswood), Limited

Directors' Statement

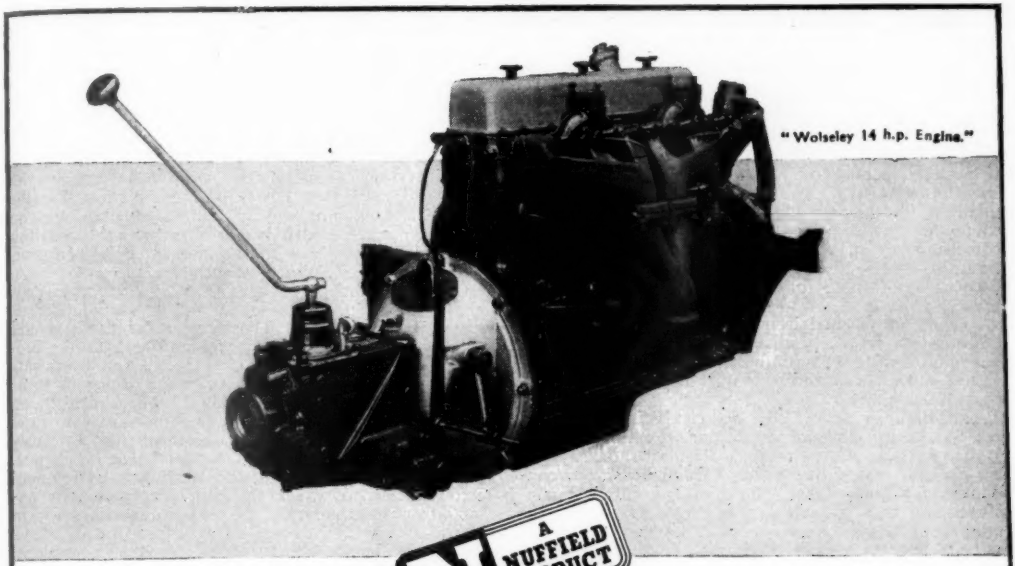
In a circular to shareholders, the directors of Douglas (Kingswood), Limited, motor-cycle and engine manufacturers, ironfounders, etc., of Kingswood, near Bristol, announce that a receiver and manager has been appointed until a scheme of reconstruction can be evolved. The appointment follows a request from the Westminster Bank after it had refused to increase the company's overdraft by £100,000 to £780,000 for a period of six months. Coupled with this request, the directors offered to the bank such financial control as it might desire and to place their resignations in its hands. In the alternative, the bank was asked to appoint a receiver and manager who would carry on the business until such time as a scheme of reconstruction could be evolved. The bank has elected to follow the latter course, and, consequently, Mr. Walker, of the firm of Latham & Company, will be appointed receiver and manager.

The directors state that it is a matter of deep regret to them that this step should have become necessary at the moment when they believe that their efforts to pull the company round are meeting with success. The management is prepared to remain at its posts and to help the receiver as much as possible.

Company News

(Figures for previous year in brackets.)

Banks & Davis—Interim dividend of 75% (same).
Metal Agencies—Interim dividend of 10% (same).
Willson Lathes—Interim dividend of 12½% (same).
Kitchen & Wade—Interim dividend of 12½% (same).
Erinoid—Dividend of 15% (15% and bonus of 5%).
International Linotype—Interim dividend of 5% (3%).
Rawlplug Company—Interim dividend of 10% (same).
Revo Electric Company—Interim dividend of 5% (same).
George M. Callender & Company—Dividend of 24.466% (same).
United Steel Companies—Final dividend of 5½% making 8% (same).
Cochran & Company Annan—Final dividend of 5%, making 6½%, tax free (same).
Henry Norrington & Son—Dividend of 22½%. The company was made public last November.
John I. Thornycroft & Company—Final dividend of 10% and bonus of 7½%, making 22½% (same).
Metropolitan Electric Cable & Construction Company—Interim dividend of 10% (15%). No final dividend was declared last year.
Canadian Car & Foundry Company—Quarterly dividend of 20 cents per share on the ordinary shares (same) and bonus of 20 cents (nil).
Alexander Stephen & Sons—Profit for the year ended March 31, after charging depreciation and making provision for taxation, £88,420; profit on sale of investment, £5,892; to general reserve, £100,000; final dividend of 8% and bonus of 3%, making 18% (same); forward, £121,527 (£150,651).
Oxley Engineering Company—Net profit of parent company to June 30, £20,181 (£20,440); net profit of group, £37,635 (£33,016); forward—parent, £14,028 (£10,347), group, £45,316 (£24,181). The accounts of two subsidiaries are in respect of the 15-month period to June 30. Dividend of 15% (same).
T. M. Birkett & Sons—Consolidated trading profit for the year to July 31, £139,986; other income, £549; to taxation, £88,435 (including provision income tax 1949-50, £41,042); depreciation, £8,555; audit fees, £365; directors' remuneration, £7,616; net profit, £35,564; dividend of 30% (same); forward, £54,019 (£39,905).
Villiers Engineering Company—Trading balance to July 31, £259,898; other income, £926; to depreciation, £40,000; plant reserve, £9,300; profits tax, £28,000; additional tax of previous year, £4,358; income tax, £90,113; net profit, £89,053; to dividend of 15%, £20,625; benefit fund, £5,000; "Farrer Hall" fund, £5,000; forward, £169,846.
Wombwell Foundry & Engineering Company—Trading profit to July 31, £31,345 (£22,836); to depreciation, £5,138 (£2,500); directors' fees, £750 (same); directors' service remuneration, £4,305 (£3,964); registrar's fees, £344 (£355); audit fee, £155 (same); tax, £11,746 (£6,025); leaving, £8,907 (£9,087); final dividend of 11½%, making 17½% (same); forward, £8,405 (£8,257).
Sheffield Forge & Rolling Mills—Trading profit for the year to June 30, £86,243 (£54,286); income from trade investments, £2,431 (£948); to depreciation, £10,912 (£7,500); directors' emoluments, £5,034 (£4,267); bank interest, nil (£180); net profit, before taxation, £72,728 (£43,287); surplus provisions existing at June 30, 1947, £12,394 (nil); to taxation, £40,219 (£24,636); plant replacement reserve, £22,500 (£12,500); general reserve, £15,000 (nil); dividend of 15% (same); forward, £9,708 (£9,049).
Aerialite—Trading profit for the year to May 31, £150,679 (£141,887); to directors' remuneration and fees, £18,064 (£17,368); depreciation, £5,372 (£5,200); audit fee, £650 (£500); net profit, before tax, £126,593 (£118,819); to taxation, £77,100 (£78,625); expenses *re* new capital written off, £1,748 (£500); preference dividend, £1,210 net (£1,320); reserve for preference dividend from April 30 to May 31, £110 (same); ordinary dividend of 150% (same), £23,894 net (£20,385); forward, £48,816 (£26,285).
Leeds Fireclay Company—Group profit and loss account for the year ended June 30 shows trading profit of parent company £43,419 and that of subsidiaries £40,984, making £84,403; sundry income, £5,376; to depreciation, £14,314; kiln renewals, £12,949; debenture interest, £8,074; directors' remuneration, £7,388; audit fees, £598; tax, £4,629; net profit of group, £41,827 (£50,642); brought in, £31,175; previous undistributed subsidiary profits, £7,178; to dividend of 8% on the preferred ordinary shares (same); ordinary dividend of 6% (same); tax reserve, £10,000; forward, £44,880.
Braithwaite & Company Engineers—Consolidated profit and loss account for the year to March 31 shows: Balance brought forward from trading accounts, £244,946 (£132,128); dividend from Braithwaite (India), £11,739 (£13,037); interest, £726 (£722); to auditors' remuneration and expenses, £1,500 (£1,000); bank interest, £4,047 (nil); pension and life assurance funds, £3,082 (£3,666); deferred repairs, nil (£27,414); depreciation of buildings, plant, etc., £26,781 (£16,741); taxation (after Dominion relief £4,740), £123,000 (£60,000); net profit, £99,001 (£37,066); dividend of 7½ per cent. (same) net general taxation reserve, £85,000 (nil); forward, £59,132 (£61,904, subject to directors' fees £1,600).
Morphy-Richards—Consolidated profits, less loss, to June 30, £114,156; to directors' fees, £1,050; other emoluments, £12,923; royalties, £25; audit, £533; depreciation, £5,827; development, £8,956; profit, £84,842; to profits tax, £15.000; income tax (before taking credit for initial allowances amounting to £1,200), £31,306; taxes abroad, £1,322; net profit, £37,214; to preliminary expenses of subsidiary, £44; profit of a subsidiary acquired on September 30, 1947, attributable to period prior to acquisition used to write down goodwill, £226; to minority holders, £1,799; balance to Morphy-Richards, £35,145; to profits, less loss, of subsidiaries not dealt with in accounts of Morphy-Richards, £940; to profit, £34,205; brought in, £21,587; to net under-provision for taxation, £2,250; dividend from a subsidiary in respect of a previous period, £254; dividend of 160% (same); balances forward—Morphy-Richards, £29,596, subsidiaries £2,085, less £1,095 off goodwill, leaving £990.



A NUFFIELD PRODUCT

Using

STANTON-DALE

REFINED PIG IRON

USED AND RECOMMENDED
FOR ALL HIGH-DUTY
ENGINEERING CASTINGS

THE STANTON IRONWORKS COMPANY LIMITED, Nr. NOTTINGHAM

Raw Material Markets

Iron and Steel

Expansion of pig-iron production, which is still rather below the weekly rate of output in the second quarter of the year, has become an immediate objective. Foundries are busy, but outputs could certainly be increased if more iron and more labour were available. Happily, the shortage of the various types of merchant iron used in the production of light and heavy castings does not extend to basic iron, current supplies of which are ample for the needs of the steel-melting furnaces. Refined iron also commands a brisk sale, being now extensively used as a substitute for low-phosphorus and hematite grades.

Makers of finished iron experience no difficulty in clearing their relatively small outputs. There are plenty of inquiries for crown and best bars from the shipyards and wagon builders and works are fully booked to the end of the year.

The extra shipments of steel semis from Belgium and Luxemburg have helped to ease the supply position at the re-rolling mills, but the problem of short supplies has not been wholly overcome. Sheetmakers are in constant need of bars and slabs to keep the mills fully employed and small billets are also sought in larger quantities than are at present available. All sorts of scrap and defective billets are being used to make good the deficiency in primes, until such time as the further expansion of home production is possible.

Apart from the sheet trade, which is inundated with orders from home sources and for export, the strongest feature of the steel market is the demand for plates. Record outputs will be required to meet the specifications in hand for the current period and authorisations extend far into 1949. Producers of joists, channels and sections also have very heavy commitments and but for the very careful system of rationing the position would be chaotic. Rail mills have big rolling programmes in hand and there is no perceptible diminution in the call for colliery material. Wire mills, too, have well-filled order-books, but production is not at its maximum owing to the dearth of rods. Tubemakers are pressing for ingots and strip.

Non-ferrous Metals

American copper statistics for September show a quite remarkable rise in domestic deliveries and a sharp fall in the stocks of refined metal. Production of blister copper during the month was 88,071 short tons, against 88,496 tons in August, and of refined, 102,976 short tons, compared with 102,798 tons. Stocks of refined copper declined from 81,946 tons at August 31, to 72,215 tons at the end of September, while domestic deliveries increased from 106,407 tons to 123,188 short tons.

This is a picture of great activity and not calculated to encourage hopes that a price reduction is imminent. Actually, the tone of all the non-ferrous metals in the United States is strong, particularly in zinc and lead, where the scarcity appears to be most pronounced. The former was, in fact, advanced in price recently to 15¼ cents per lb., a gain of 50 points, and it will be surprising of another rise of 50 points is not added shortly, bringing the level to 16 cents. This is equal to about £89 10s. per ton, which could constitute a threat to our present quotation of £92 per ton, delivered consumers' works. Moreover, it does not follow that the Ministry of Supply can buy on the world market at the U.S. domestic price, for the American users are seeking both lead and zinc on overseas markets and it is doubtful whether the British Government could buy at the moment below 16 cents per lb., c.i.f. U.K. port.

Distasteful though it may be, the tendency of non-ferrous metal prices is still upwards, and, indeed, it would be strange were it otherwise, for there is still an overall insistent demand and no check to the producers' practice of protecting their position by raising quotations. Moreover, the stockpiling factor must be considered; while no one believes that the United States Government is anything but averse to helping to raise prices, the building up of a large reserve is obviously a bull factor—at present. It cannot be anything else, for the Government is competing with industry for non-ferrous metals, of which the supply at present is unequal to the demand. High as the quotations are in America, they are not too high for United States traders to finance stocks and current transactions. But in the United Kingdom the burden is serious, and a further rise in world prices, dictated, of course, by the level in New York, would be most serious for the British metal industry.

Mr. E. W. Senior's Appointment

Sir John Duncanson has resigned from his position as commercial and technical director of the British Iron and Steel Federation. He is returning to Scotland to be associated in certain interests with Sir James Lithgow. Sir John joined the Iron and Steel Control at the beginning of the war and succeeded to the Controllership in 1942. This position he held until July, 1945, when he assumed his appointment with the Federation.

He will be succeeded as commercial director of the Federation by Mr. Edward W. Senior, Master Cutler of Sheffield for 1948. Mr. Senior also served throughout the war in the Iron and Steel Control, being General Director of Alloy and Special Steels, and then was the representative of the Control in Washington for some two years during the war, after which he returned to become Controller of the Ball-bearing Industry, resigning at the end of the war to return to his own interests in Sheffield.

The changes will be effective from early in 1949.

STONE-WALLWORK, LIMITED, has appointed Mr. W. R. G. Johnson, 30, Chestnut Drive, Erdington, Birmingham, as its Midlands representative.